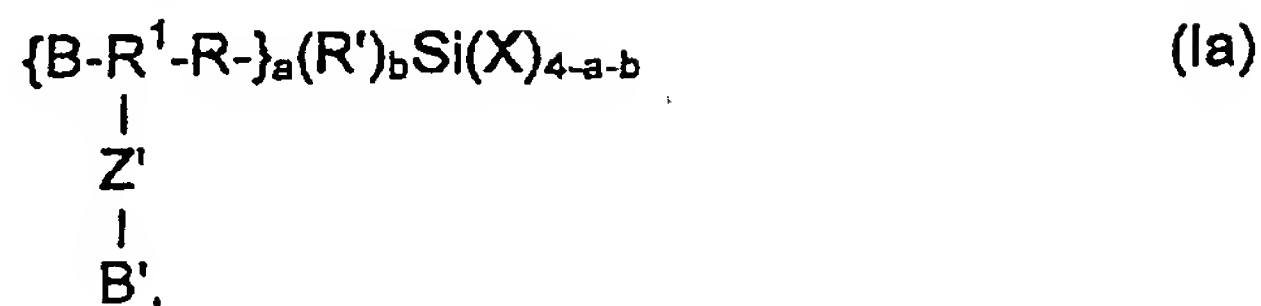


Claims

1. Silane of the structure (I) below



where the radicals and indices have the following meanings:

R is an open-chain and/or cyclic alkylene, arylene, or alkylene-arylene group, with 1 to 10 carbon atoms in each case, which can be interrupted by one or more oxygen or sulfur atoms or carboxyl or amino groups or can carry such atoms/groups at their end opposite the silicon atom,

R¹ is a Z'-substituted, open-chain and/or cyclic alkylene, arylene, or alkylene-arylene group, with 1 to 10 carbon atoms in each case, which can be interrupted by one or more oxygen or sulfur atoms or carboxyl or amino groups or can carry such atoms/groups at their end opposite the silicon atom,

R' is an open-chain and/or cyclic alkyl, alkenyl, aryl, or alkylaryl, or arylalkyl group, with preferably 1 to 20 carbon atoms,

B and B' can be the same or different, both radicals can have the meaning of a straight-chain or branched organically polymerizable group with at least one C=C double bond and at least 2 carbon atoms, instead of this B' can also mean -R²_aSiX_{4-a} or -R²_aR¹_bSiX_{4-a-b}, where R² is an alkylene group with 1 to 10 carbon atoms and R' is defined as above,

X is a group which can enter into a hydrolytic condensation reaction with the formation of Si-O-Si bridges,

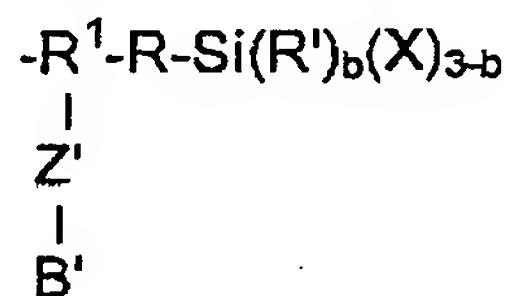
Z' has the meaning -NH-C(O)O-, -NH-C(O)-, or -CO(O)-, where the two radicals named first are bonded via the NH group to the group B' while the carboxylate group can point in both directions, where, when Z' is a -CO(O)- group, its carbon atom is bonded to the radical B', the grouping B'-Z'- may not have the meaning of an acrylate group if B comprises an acrylate group, and the grouping B'-Z'- may not be a methacrylate group if B comprises a methacrylate group,

a means 1 or 2, and

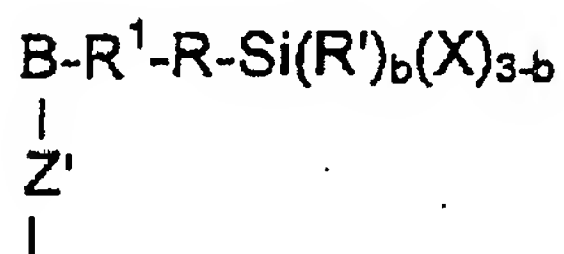
b is 0 or 1.

2. Silane according to claim 1, in which
R¹ is a group with 1 to 10, preferably 1 to 4, carbon atoms and/or
B and optionally also B' carries at least one Michael system, particularly preferably an acrylate or methacrylate group, and/or
X is a C₁-C₁₀ alkoxy group.
3. Silane according to claim 1 or 2, in which
the radicals B and optionally also B' are acrylic acid ester groups and/or methacrylic acid ester groups of trimethylolpropane, of glycerin, of pentaerythritol, of C₂-C₄-alkane diols, of polyethylene glycols, of polypropylene glycols, or in given cases substituted and/or alkoxyated, bisphenol A or comprise these esters.
4. Silane according to one of the foregoing claims in which
the radicals B and optionally also B' comprise an end-to-end carbon skeleton or this skeleton is interrupted by heteroatoms or groups chosen from among O, S, SO, NH, NHCO, PR, POR, CONHCO, COO, NHCOO.
5. Silane according to one of the foregoing claims in which a is equal to 1 and b is equal to 0.
6. Silane according to one of the foregoing claims in which a is equal to 1 and b is equal to 1.
7. Silane according to one of the foregoing claims, in which B is a (meth)acrylate group or comprises a radical which is bonded via a (meth)acrylate group to R¹ and comprises no additional or one, two, or three (meth)acrylate groups.
8. Silane according to one of the foregoing claims, in which B is bonded via a group Z to R¹, where Z is an -O-C(O)-, -S-C(O), or -NH-C(O)- group if Z' is -NH-CO- and Z is -O-R⁴, -S-R⁴, -NH-R⁴, -C(O)O-R⁴, -O-, -S-, -NH-, or -C(O)O- if Z' is -NH-C(O)O-, where R⁴ has the meaning alkylene, arylene, or alkylarylene with preferably 1 to 10 (for ringless groups) or 6 to 14 (for ring-containing groups) carbon atoms.

9. Silane according to one of the foregoing claims and in particular according to claim 7, in which Z has the meaning -NH-C(O)O- or -NH-C(O).
10. Silane according to one of the foregoing claims and in particular according to claim 7 and/or claim 9, in which b means zero.
11. Silane according to one of claims 1 to 9 and in particular according to claim 7 and/or claim 9, in which b is 1 and R is a C₁-C₄ alkyl group.
12. Silane according to one of the foregoing claims, in which B is a (meth)acrylate group or comprises a radical which is bonded via a (meth)acrylate group to R' and comprises no additional or one, two, or three (meth)acrylate groups.
13. Silane according to one of claims 1 to 11, in which B is a dialkoxyalkylsilylalkylene group with 1 to 4 carbon atoms in the alkyl and alkoxy groups and 1 to 8 carbon atoms in the alkylene group.
14. Silane according to one of the preceding claims, in which B comprises at least one additional group

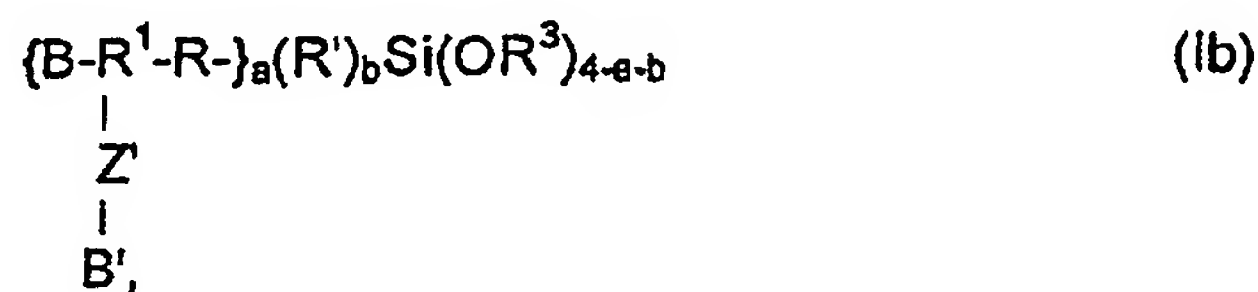


or B' comprises at least one additional group



where the radicals and indices have the meanings specified in claim 1 for the structure (1a).

15. Silicic acid polycondensate or partial polycondensate with the following structure (Ib)



where the radicals and indices have the following meanings:

R is an open-chain and/or cyclic alkylene, arylene, or alkylene-arylene group, with 1 to 10 carbon atoms in each case, which can be interrupted by one or more oxygen or sulfur atoms or carboxyl or amino groups or can carry such atoms/groups at their end opposite the silicon atom,

R¹ is a Z'-substituted, open-chain and/or cyclic alkylene, arylene, or alkylene-arylene group, with 1 to 10 carbon atoms in each case, which can be interrupted by one or more oxygen or sulfur atoms or carboxyl or amino groups or can carry such atoms/groups at their end opposite the silicon atom,

R' is an open-chain and/or cyclic alkyl, alkenyl, aryl, or alkylaryl, or arylalkyl group, with preferably 1 to 20 carbon atoms,

the radicals R³ are the same or different, both radicals have at least in part the meaning of a bond to another silicon atom and otherwise represent a hydrogen atom, an alkyl group with 1 to 10 carbon atoms, or a bond to another metal atom which can be inserted into silicic acid heteropolycondensates,

B and B' can be the same or different, both radicals can have the meaning of a straight-chain or branched organically polymerizable group with at least one C=C double bond and at least 2 carbon atoms, instead of this B' can also mean -R²_aSiX_{4-a} or -R²_aR¹_bSiX_{4-a-b}, where R² is an alkylene group with 1 to 10 carbon atoms and R' is defined as above,

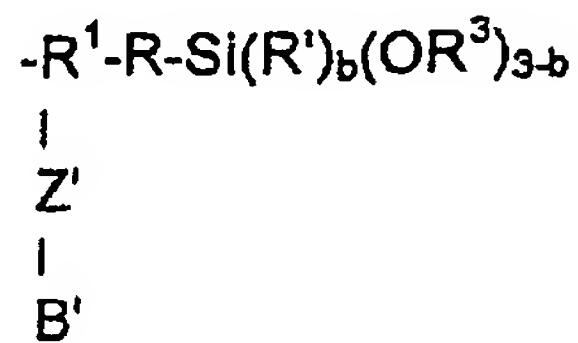
Z' has the meaning -NH-C(O)O-, -NH-C(O)-, or -CO(O)-, where the first two radicals named are bonded via the NH group to the group B' while the carboxylate group can point in both directions, where, when Z' is a -CO(O)- group, its carbon atom is bonded to the radical B', the grouping B'-Z'- may not have the meaning of an acrylate group if B comprises an acrylate group, and the grouping B'-Z'- may not be a methacrylate group if B comprises a methacrylate group,

a means 1 or 2, and

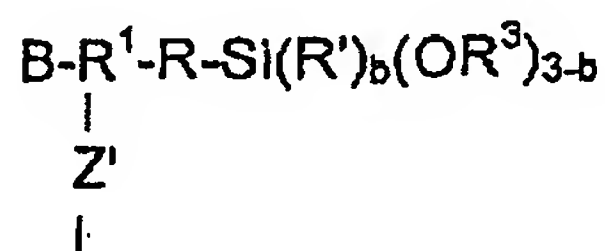
b can be 0 or 1.

16. Silicic acid polycondensate or partial polycondensate according to claim 15, in which
R¹ is a group with 1 to 10, preferably 1 to 4, carbon atoms and/or
B and optionally also B' carries at least one Michael system, particularly preferably an acrylate or methacrylate group, and/or
X is a C₁-C₁₀ alkoxy group.
17. Silicic acid polycondensate or partial polycondensate according to claim 15 or 16, in which
the radicals B and optionally also B' are partially or completely (meth)acrylic radicals and/or acrylic acid ester groups and/or methacrylic acid ester groups of trimethylolpropane, of glycerol, of pentaerythritol, of C₂-C₄-alkane diols, of polyethylene glycols, of polypropylene glycols, or of, in given cases substituted and/or alkoxyated, bisphenol A or comprise these esters.
18. Silicic acid polycondensate or partial polycondensate according to one of the claims 15 to 17 in which
the radicals B and optionally also B' comprise an end-to-end carbon skeleton or this skeleton is interrupted by heteroatoms or groups chosen from among O, S, SO, NH, NHCO, PR, POR, CONHCO, COO, NHCOO.
19. Silicic acid polycondensate or partial polycondensate according to one of the claims 15 or 18 in which a is equal to 1 and b is equal to 0.
20. Silicic acid polycondensate or partial polycondensate according to one of the claims 15 or 18 in which a is equal to 1 and b is equal to 1.

21. Silicic acid polycondensate or partial polycondensate according to one of claims 15 to 20, in which B comprises at least one additional group



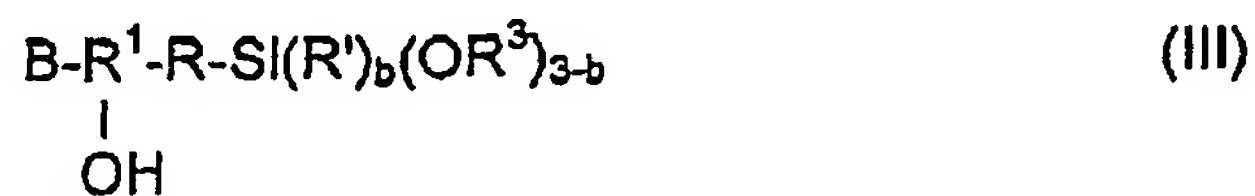
or B' comprises at least one additional group



where the radicals and indices have the meanings specified in claim 15.

22. Silicic acid polycondensate or partial polycondensate according to one of claims 15 to 21, consisting of or comprising a mixture of structural elements of the structure (Ib) with different meanings for the radicals and indices.
23. Silicic acid polycondensate or partial polycondensate according to claim 15, obtained through hydrolysis and condensation of one or more silanes with one of the structures as defined in claims 1 to 14.
24. Silicic acid polycondensate or partial polycondensate according to claim 23, obtained through hydrolysis and condensation of a mixture of one or more silanes with one of the structures as defined in claims 1 to 14 as well as one or more additional silanes and/or one or more hydrolyzable metal compounds chosen from among hydrolyzable metal compounds of boron, aluminum, germanium, tin, titanium, and zirconium.

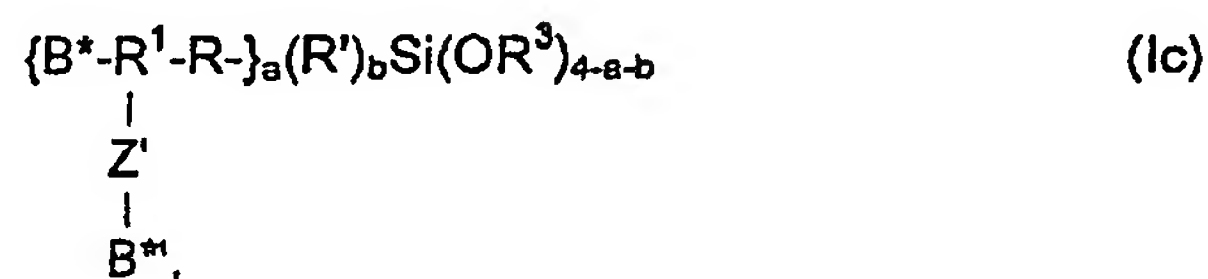
25. Silicic acid polycondensate or partial polycondensate according to one of claims 15 to 23, furthermore comprising a structural element (III)



in which the radicals and indices have the meaning specified above for the structure (Ib) in claim 15.

26. Silicic acid polycondensate or partial polycondensate according to claim 25 in which the portion of structural elements of the formula (III), relative to the portions of structural elements of the formula (Ib), lies in the range of 5 to 70%, preferably in the range of 10 to 50%.
27. Silicic acid polycondensate or partial polycondensate according to one of claims 15 to 26, which is free from polymerizable organic monomers.
28. Organic polymerizable material (composite), comprising a silicic acid polycondensate or partial polycondensate according to one of claims 15 to 27 as well as a filling material.
29. Organic polymerizable material (composite) according to claim 28, in which the filling material consists of glass or ceramics.
30. Use of a silicic acid polycondensate or partial polycondensate according to one of claims 15 to 27 or an organically polymerizable material according to one of claims 28 to 29 as coating, filling, adhesive, casting, and sealing materials, as binding agents for ceramic particles, for the production of, or in the form of, fibers, particles, foils, as embedded materials or for the production of shaped bodies.

31. Organically polymerized silicic acid polycondensate or partial polycondensate of the following structure (Ic)



where the radicals and indices have the following meanings:

R is an open-chain and/or cyclic alkylene, arylene, or alkylene-arylene group, with 1 to 10 carbon atoms in each case, which can be interrupted by one or more oxygen or sulfur atoms or carboxyl or amino groups or can carry such atoms/groups at their end opposite the silicon atom,

R¹ is a Z'-substituted, open-chain and/or cyclic alkylene, arylene, or alkylene-arylene group, with 1 to 10 carbon atoms in each case, which can be interrupted by one or more oxygen or sulfur atoms or carboxyl or amino groups or can carry such atoms/groups at their end opposite the silicon atom,

R' is an open-chain and/or cyclic alkyl, alkenyl, aryl, or alkylaryl, or arylalkyl group, with preferably 1 to 20 carbon atoms,

the radicals R³ are the same or different, both radicals have at least in part the meaning of a bond to another silicon atom and otherwise represent a hydrogen atom, an alkyl group with 1 to 10 carbon atoms, or a bond to another metal atom which can be inserted into silicic acid heteropolycondensates,

B* and B** can be the same or different, both radicals can have the meaning of a straight-chain or branched organically polymerizable group with at least one C=C double bond and at least 2 carbon atoms, instead of this B** can also mean -R²_aSi(OR³)_{4-a} or -R²_aR¹_bSi(OR³)_{4-a-b}, where R² is an alkylene group with 1 to 10 carbon atoms and R' and R³ are defined as above,

Z' has the meaning -NH-C(O)O-, -NH-C(O)-, or -CO(O)-, where the two radicals named first are bonded via the NH group to the group B' while the carboxylate group can point in both directions, where, when Z' is a -CO(O)- group, its carbon atom is bonded to the radical B', the grouping B'-Z'- may not have the meaning of an acrylate group if B comprises an acrylate group, and the grouping B'-Z'- may not be a methacrylate group if B comprises a methacrylate group,

a means 1 or 2, and

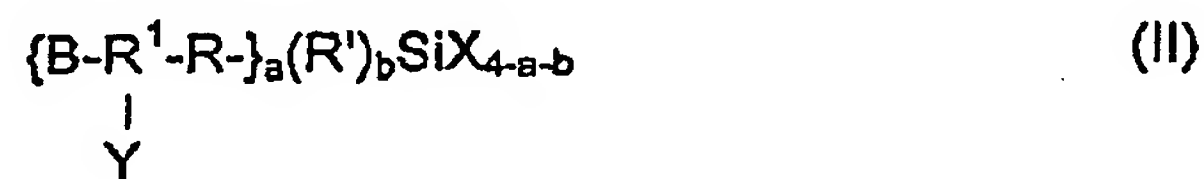
b can be 0 or 1.

32. Organically polymerized silicic acid polycondensate or partial polycondensate according to claim 31, obtained by organic polymerization of a silicic acid polycondensate or partial polycondensate according to one of claims 15 to 27.
33. Organically polymerized silicic acid polycondensate or partial polycondensate according to claim 31 or 32, additionally containing at least one filling material.
34. Copolymerizate, obtained through copolymerization of a silicic acid polycondensate or partial polycondensate according to one of claims 15 to 27 and one or more organically polymerizable monomers and/or prepolymers, chosen from among radically and/or ionically and/or covalent-nucleophilically polymerizable monomers and/or prepolymers or one or more silane-bonded cyclic systems.
35. Copolymerizate according to claim 34, in which the radically polymerizable compounds are chosen from among acrylates or methacrylates, the ionically polymerizable compounds are chosen from among ring systems which are polymerizable by cationic opening of the ring, in particular spiroorthoesters, spiroorthocarbonates, bicyclic spiroorthoesters, monoepoxides or oligoepoxides or spirosilanes, and the radically polymerizable as well as ionically polymerizable compounds are chosen from among the group of methacryloyl-spiroorthoesters.
36. Copolymerizate according to claim 34, in which the silane-bonded cyclic system is chosen from among those which comprise epoxides.

37. Process for the production of a silane with the structure (Ia) as defined in one of claims 1 to 14, comprising the following steps

- (a) preparation of a compound with the structure (II) or an isomer

a re-esterification product, or one of this compound's condensation products arising by loss of an alcohol molecule



in which B, R¹, R, R', X, a, and b have the meanings specified in claim 1 for the structure (Ia) and Y is OH or COOH,
and Y means COOH,

- (b) reaction of this compound or of the isomer, re-esterification product,
or condensation product with a compound



in which B' has the meaning specified in claim 1 for structure (Ia),

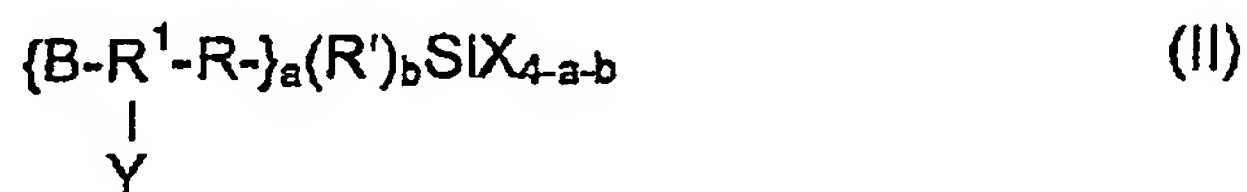
and

- (c) in given cases, workup of the product.

38. Process for the production of a silane with the formula (Ia) as defined in one of claims 1 to 14, including the following steps:

- (a) preparation of a compound with the structure (II) or an isomer

a re-esterification product, or one of this compound's condensation products arising by loss of an alcohol molecule



in which B, R¹, R, R', X, a, and b have the meanings specified in claim 1 for the structure (Ia),
and Y means COOH.

- (b) reaction of this compound or of the isomer, re-esterification product,
or condensation product with a compound

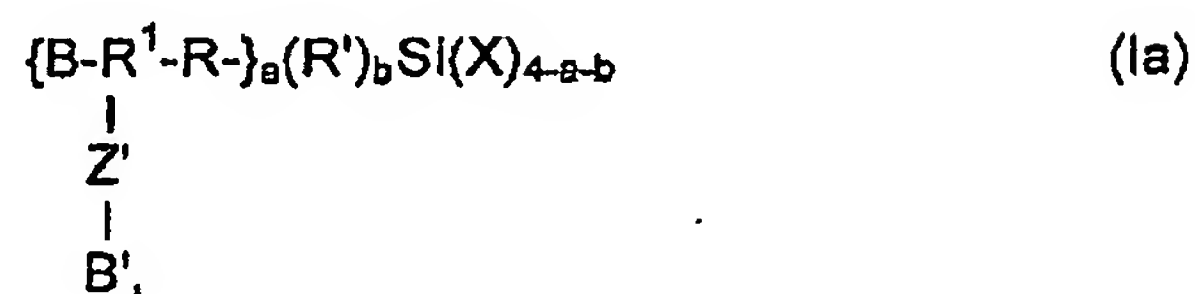


in which B' has the meaning specified in claim 1 for structure (Ia),

and

- (c) in given cases, workup of the product.

39. Process for the production of a silane with the formula (Ia)



where the radicals and indices have the following meanings:

R is an open-chain and/or cyclic alkylene, arylene, or alkylene-arylene group, with 1 to 10 carbon atoms in each case, which can be interrupted by one or more oxygen or sulfur atoms or carboxyl or amino groups or can carry such atoms/groups at their end opposite the silicon atom,

R¹ is a Z'-substituted, open-chain and/or cyclic alkylene, arylene, or alkylene-arylene group, with 1 to 10 carbon atoms in each case, which can be interrupted by one or more oxygen or sulfur atoms or carboxyl or amino groups or can carry such atoms/groups at their end opposite the silicon atom,

R' is an open-chain and/or cyclic alkyl, alkenyl, aryl, or alkylaryl, or arylalkyl group, with preferably 1 to 20 carbon atoms,

B and B' can be the same or different, both radicals can have the meaning of a straight-chain or branched organically polymerizable group with at least one C=C double bond and at least 2 carbon atoms, instead of this B' can also mean -R²_aSiX_{4-a} or -R²_aR¹_bSiX_{4-a-b},

where is an alkylene group with 1 to 10 carbon atoms and R' is defined as above.

X is a group which can enter into a hydrolytic condensation reaction with the formation of Si-O-Si bridges.

Z' has the meaning -CO(O)-, where the carboxylate group can point in both directions,

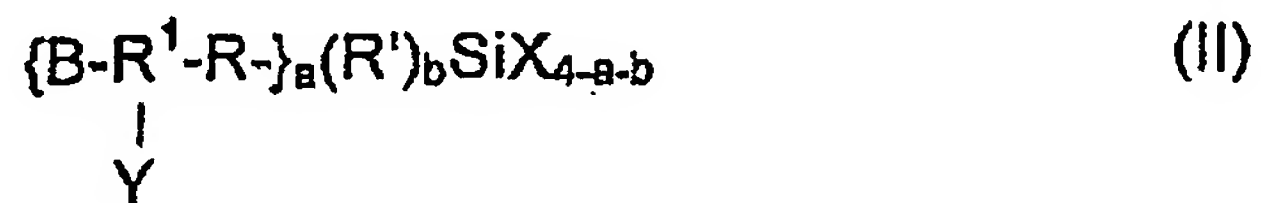
a means 1 or 2,

and b is 0 or 1

comprising the following steps:

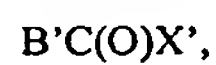
- (a) preparation of a compound with the structure (II) or an isomer

a re-esterification product, or one of this compound's condensation products arising by loss of an alcohol molecule



in which B, R¹, R, R', X, a, and b have the meanings specified in claim 1 for the structure (Ia) and Y is OH,

- (b) reaction of this compound or of the isomer, re-esterification product,
or condensation product with a compound



in which B' has the meaning specified in claim 1 for structure (Ia)

and C(O)X' is a carboxylic acid group or an activated carbonyl compound, in particular an acid chloride or an acid anhydride,
and

- (c) in given cases, workup of the product.

* * *